METHOD OF MONITORING AND CONTROLLING A PHOTORESIST EDGE BEAD

BACKGROUND OF THE INVENTION

[0001] (1) Field of the Invention

[0002] The present invention relates to methods used to form photoresist shapes on a semiconductor substrate, and more specifically to a method used to measure the width of photoresist layer removed at the periphery of the semiconductor substrate, prior to use of the photoresist shape as a masking layer.

[0003] (2) Description of Prior Art

[0004] Micro-miniaturization, or the ability to fabricate semiconductor devices with sub-micron features, has been realized via advances in specific semiconductor fabrication disciplines, such as photolithography. The use of more sophisticated exposure cameras, as well as the development of more sensitive photoresist materials, have allowed sub-micron images to be routinely formed in photoresist shapes. In turn, advances in dry etching procedures have allowed the sub-micron images, in masking photoresist shapes, to be transferred to underlying materials used as building blocks of sub-micron, semiconductor devices.

[0005] Photoresist shapes, used as a mask for definition of underlying materials, are employed numerous times during the fabrication of semiconductor devices. For example photoresist shapes can be used as mask to allow patterning, or etching of an underlying metal layer, to create a metal interconnect structure for the sub-micron, semiconductor device. In addition a photoresist layer may be used as a protective layer during a dicing procedure, used to divide a finished semiconductor substrate into individual dies or chips. However the application of a photoresist layer can result in edge bead formation, or formation of a thickened photoresist component, located at the edge, or periphery of the semiconductor substrate. The photoresist edge bead can interfere with subsequent processing procedures, such as clamping of the semiconductor substrate to a component of a dry etching tool, resulting in poor physical and electrical contact to a plasma type etching tool, possibly resulting in decreased dry etching success, not allowing the sub-micron images in the masking photoresist shape to be transferred to the underlying material. Therefore edge bead removal procedures, such the use of discharging a solvent at the periphery of the semiconductor substrate, during a spin cycle, has been used to remove photoresist from the periphery of the semiconductor substrate.

[0006] The amount of photoresist edge bead removal needed however is dependent on the specific application the photoresist layer is being used for. Again for use as a mask for definition in a dry etch tool, the width of the removed photoresist should be sufficient to allow a clamping procedure to be accomplished on a photoresist free surface, while removal of a narrower photoresist edge bead region is needed when the photoresist shape or layer, is used for a protective layer for dicing operations. Removal of a wider photoresist edge bead may uncover, and therefore not protect, dies, or chips located near the periphery of the semiconductor substrate, during a dicing operation. This invention will describe a process for monitoring and controlling the amount of photoresist edge bead removed. A test vehicle, comprised of a semiconductor wafer with specific graduations, is processed, or coated with photoresist, along with the product semiconductor wafers. After an edge bead removal step, the monitor wafer is examined to determine if the proper amount of edge bead removal had been accomplished for that specific photoresist application. The monitoring procedure can be followed by a photoresist rework procedure for the product semiconductor substrates if the removal of photoresist edge bead, on the monitor wafer, was unsatisfactory.

[0007] Therefore this invention will provide a method of monitoring and controlling the width of photoresist edge beads, as well as describing a structure used for quantitative evaluation of photoresist edge bead width. Prior art, such as Nguyen et al, in U.S. Pat. No. 6,057,206, as well as Jones et al, in U.S. Pat. No. 6,117,778, show photoresist shapes with peripheral edge beads removed, however these prior arts do not show the method used, and monitoring vehicle employed, in this present invention, used to quantitatively measure, or monitor, the width of the removed photoresist edge bead.

SUMMARY OF THE INVENTION

[0008] It is an object of this invention to provide a method for monitoring the width of photoresist edge bead removed.

[0009] It is another object of this invention to provide a test vehicle, featuring readable engraved scribed marks located at specific distances from the periphery of a semiconductor substrate, to allow a quantitative measure of the extent of photoresist edge bead removal to be performed.

[0010] In accordance with the present invention a method of monitoring and controlling the width of photoresist edge bead removed at the periphery of a photoresist semiconductor substrate, as well as the test vehicle used for quantitative evaluation of the width of the photoresist edge bead removed, is described. A semiconductor substrate, used for monitoring purposes only, is prepared with sets of laser scribe marks, formed to a specific depth in the substrate and with each specific scribe mark placed, and identified, at a specific distance from the periphery of the monitoring substrate. The monitoring substrate along with the product semiconductor substrates are coated with a photoresist layer, and then prior to exposure and development procedures, subsequently to be performed to the photoresist layer on the product semiconductor substrates, are subjected to a procedure used to remove photoresist from the periphery of the substrates. The width of the removed photoresist edge bead is then determined via observance of the uncovered scribe mark on the monitoring semiconductor substrate, nearest the edge of the remaining photoresist layer. Rework, stripping and recoating of photoresist, is performed on both product and monitoring semiconductor substrates, if the width of the measured photoresist edge bead removed was not acceptable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The object and advantages of this invention are best described in the preferred embodiment with reference to the attached drawings that include:

[0012] FIGS. **1-2**, which schematically show a top view of a monitoring semiconductor substrate, featuring scribe